

2007 SCEC ANNUAL REPORT

Late Holocene Earthquake History of the Imperial Fault: A Test of Earthquake Recurrence Models

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The Imperial fault is the only fault in southern California to have ruptured twice in the past century. The fault ruptured end-to-end in a M 6.9 earthquake in 1940, producing surface rupture over its entire 64-km length, and in 1979, surface rupture was again produced during a M 6.4 earthquake, but only along the fault's northern segment. The overall trend of the Imperial fault is to the northwest and the sense of slip is predominantly dextral, although adjacent to Mesquite Basin along the fault's northernmost stretch, there is also an extensional east-side-down slip component and the fault dips to the east. At our field site near the intersection of Dogwood and Harris Roads, the overall scarp height locally exceeds 2.5 m. This height includes slip from the 1940 and 1979 earthquakes, and some of it may represent pre-lake slip, as the lake clays were deposited across a preexisting scarp. This and other issues will be addressed by our work.

By excavating two trenches near Dogwood and Harris Roads along the Imperial fault, our study of the earthquake history of the northernmost third of the Imperial fault should establish how often earthquakes have occurred (at least in the past 3-4 centuries) and should test competing rupture models (characteristic, slip-patch, and slip-loading) for this fault. This information is critical for improving seismic hazard analysis and earthquake forecast models, and it should improve our overall understanding of fault behavior.

In order to get a complete record for the past few centuries, we plan to excavate two trenches tens of meters apart, just east of Dogwood Road. One trench will cross the fault where it comprises two strands, several meters apart, and the other trench will cross the fault where there is a single principal strand. These two trenches, combined with findings from an earlier exploratory trench, examined and logged by Meltzner and Rockwell several hundred meters farther northwest in 2003, should resolve the earthquake history of the northern Imperial fault for the past 300-400 years and possibly longer. In this way, we will see if the northern Imperial fault produces frequent 50-70 cm slip events as predicted in the slip-patch model of Sieh, or whether there have only been large end-to-end ruptures or 1940/1979-type couplets suggesting the alternative slip-loading model proposed by Meltzner and Rockwell.

Originally, after learning of our funding in April 2007 (and unable to start field work on only a few weeks' notice), we had hoped to conduct field work during the cooler

months of October and November, 2007. However, Meltzner's primary field area (for his ongoing Ph.D. thesis) is along the Sunda megathrust off Sumatra, Indonesia. The occurrence of two earthquakes of $M \geq 7.9$ along that fault in September 2007 required an unanticipated trip for Meltzner to Sumatra in October 2007 for a post-earthquake field investigation. This, in turn, required us to postpone the Imperial fault study.

We are now planning to open the trenches in early April 2008, and we hope to have completed field work by early May 2008. We will draft logs and complete a manuscript over the following 9 months. We will include the final results in a SCEC summary report next year, and we hope to have a final manuscript submitted for publication soon thereafter—if not earlier.